ITUPublications
Recommendations

International Telecommunication Union
Standardization Sector

Recommendation

ITU-T J.224 (10/2022)

SERIES J: Cable networks and transmission of television, sound programme and other multimedia signals

Interactive systems for digital television distribution (DOCSIS third to fifth generations)

Fifth-generation transmission systems for interactive cable television services – IP cable modems

Recommendation ITU-T J.224

Fifth-generation transmission systems for interactive cable television services – IP cable modems

Summary

Recommendation ITU-T J.224 specifies the fifth generation of high-speed data-over-cable systems. Fifth generation transmission systems introduce a number of new features that build upon what was present in previous ITU-T Recommendations, namely ITU-T J.112, ITU-T J.122, the ITU-T J.222.x-series and the ITU-T J.223.x-series. Recommendation ITU-T J.224 includes key new features for the physical (PHY) layer and establishes a full duplex data-over-cable service interface specification (DOCSIS) mode of operation, including enhancements to media access control (MAC) layer protocols, as well as requirements for those in the upper layer, e.g., the Internet protocol (IP) and dynamic host configuration protocol (DHCP). Fifth generation cable modem specifications fully incorporate those of the fourth generation.

NOTE – The structure and content of Recommendation ITU-T J.224 has been organized for ease of use through direct reference to the original source material, based on the recognition of CableLabs by ITU in accordance with Recommendation ITU-T A.5.[1].

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T J.224	2019-07-29	9	11.1002/1000/13970
2.0	ITU-T J.224	2020-05-29	9	11.1002/1000/14277
3.0	ITU-T J.224	2022-10-29	9	11.1002/1000/15116

Keywords

Data-over-cable service interface specification, DOCSIS.

---

1 Recommendation ITU-T A.5 (2019), *Generic procedures for including references to documents of other organizations in ITU-T Recommendations*. See: https://www.itu.int/en/ITU-T/extcoop/Pages/sdo.aspx

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T J.224

Fifth-generation transmission systems for interactive cable television services – IP cable modems

1 Scope

This Recommendation specifies the fifth generation of high-speed data-over-cable systems. Fifth generation transmission systems introduce a number of new features that build upon what was present in previous ITU-T Recommendations, namely [b-ITU-T J.112], [b-ITU-T J.122], [b-ITU-T J.222.x] and [b-ITU-T J.223.x] listed in Appendix I. This Recommendation includes key new features for the physical (PHY) layer and establishes full duplex (FDX) and frequency division duplex (FDD) data-over-cable service interface specification (DOCSIS) modes of operation, including enhancements to the media access control (MAC) layer protocols, as well as requirements for those in the upper layer, e.g., the Internet protocol (IP) and dynamic host configuration protocol (DHCP). Fifth generation cable modem specifications fully incorporate those of the fourth generation. [b-ITU-T J-Sup.10] records the correspondence between DOCSIS specifications and ITU-T Recommendations.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[DOCSIS CCAP-OSSIv4.0] Cable Television Laboratories, Inc., CM-SP-CCAP-OSSIv4.0-I07-220629 (2022), *Data-over-cable service interface specifications, DOCSIS 4.0 – CCAP operations support system interface, specification*. Cable Television Laboratories, Inc.

[DOCSIS CM-OSSIv4.0] Cable Television Laboratories, Inc., CM-SP-CM-OSSIv4.0-I06-220302 (2022), *Data-over-cable service interface specifications, DOCSIS 4.0 – Cable modem operations support system interface, specification*. Cable Television Laboratories, Inc.

[DOCSIS MULPIv4.0] Cable Television Laboratories, Inc., CM-SP-MULPIv4.0-I05-220328 (2022), *Data-over-cable service interface specifications, DOCSIS 4.0 – MAC and upper layer protocols interface, specification*. Cable Television Laboratories, Inc.

[DOCSIS PHYv4.0] Cable Television Laboratories, Inc., CM-SP-PHYv4.0-I05-220328 (2022), *Data-over-cable service interface specifications, DOCSIS 4.0 – Physical layer specification*. Cable Television Laboratories, Inc.

[DOCSIS SECv4.0] Cable Television Laboratories, Inc., CM-SP-SECv4.0-I04-220328 (2022), *Data-over-cable service interface specifications, DOCSIS 4.0 – Security specification*. Cable Television Laboratories, Inc.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 frequency division duplex (FDD) data-over-cable service interface specification (DOCSIS) mode: An extension of the fourth generation of cable modem specifications supporting legacy high-split and also providing extended splits up to 684 MHz in an operational band plan which is referred to as ultra-high split (UHS). The FDD mode of operation also introduces expansion of usable downstream spectrum up to 1794 MHz.

3.2.2 full duplex (FDX) data-over-cable service interface specification (DOCSIS) mode: An extension of the fourth generation of cable modem specifications that is targeted at significantly increasing upstream capacity by using the spectrum currently used for downstream transmission for simultaneous upstream and downstream communications.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data-Over-Cable Service Interface Specification
FDD	Frequency Division Duplex
FDX	Full Duplex
IP	Internet Protocol
MAC	Media Access Control
OFDM	Orthogonal Frequency Division Modulation
PHY	Physical
QAM	Quadrature Amplitude Modulation
UHS	Ultra-high Split

For other abbreviations, see clause 4 – *Abbreviations and Acronyms* in each of the specifications listed in clause 2.

5 Conventions

None.

6 Overview of fifth generation high-speed data-over-cable systems

6.1 Specifications for fifth generation high-speed data-over-cable systems

With fifth generation high-speed data-over-cable systems, global technical specifications have been achieved. As such, it is a general practice of cable operators worldwide to reference the same high quality CableLabs specifications when making purchasing decisions. These specifications have been readily and widely available since late 2019, but certification of cable modem devices has not yet occurred.

The fifth-generation high-speed data-over-cable systems specifications are also known as DOCSIS 4.0 specifications.[2]

The DOCSIS 4.0 specifications introduce a number of features that increase the capability and application of the technology as follows.

1) The use of orthogonal frequency division modulation (OFDM) in both upstream and downstream increasing the transmission efficiency (expressed in bits per hertz) over single carrier quadrature amplitude modulation (QAM). OFDM enables higher bandwidth capacity over the same amount of spectrum when compared to previous generations of DOCSIS with the potential for 10 Gbit/s service tiers over coax.
2) The specification of a full duplex (FDX) mode of operation enabling the concurrent use of spectrum for both upstream and downstream transmission, greatly increasing the upstream capacity. This provides the ability to provide symmetric multi-gigabit services over coax.
3) The specification of a frequency division duplex (FDD) mode of operation supporting legacy high-split and also providing extended splits up to 684 MHz in an operational band plan which is referred to as ultra-high split (UHS). The FDD mode of operation also introduces expansion of usable downstream spectrum up to 1794 MHz.
4) The specification of multiple modulation profiles enabling cable modems to operate at different modulation orders and to dynamically optimize the transmission capacity for the channel conditions it is experiencing. This improves the operational efficiency by not constraining all cable modems to operate at the lowest modulation order supported by the network.
5) The specification of full-band spectrum capture that enables analysis of the full spectrum as measured from the cable modem enabling sophisticated proactive diagnostics of network issues prior to customer impacting events.
6) The specification of additional security features to enhance the robustness of the DOCSIS network in the face of malicious cyberattacks.

This Recommendation is comprised of the specifications identified in clause 2. Preceding relevant ITU-T Recommendations are listed in Appendix I. Other references for the specifications listed in clause 2 are provided in the bibliography.

6.2 CableLabs DOCSIS certification programme

In addition to developing the specifications for DOCSIS, CableLabs also conducts interoperability and compliance testing to validate products that implement the DOCSIS specifications. Details of the CableLabs certification programme can be found at: https://www.cablelabs.com/specs/certification/.

The DOCSIS specifications are living documents and are updated three to four times per year under a strict engineering change request and document control process. Consequently, it is important that manufacturers of DOCSIS products understand exactly the requirements against which they are being tested for certification. The CableLabs specification and certification process links engineering change requests with certification testing with sufficient time allowed for manufacturers to implement the required changes. In this way, knowing when a product has been certified, it is possible to know exactly which version of the DOCSIS specifications was used.

[2] DOCSIS® is a registered trademark of Cable Television Laboratories, Inc. and is used in ITU-T Recommendations with permission.

Appendix I

Preceding relevant ITU-T Recommendations

(This appendix does not form an integral part of this Recommendation.)

The following list provides preceding relevant ITU-T Recommendations:

[b-ITU-T G.8275.1] Recommendation ITU-T G.8275.1/Y.1369.1 (2016), *Precision time protocol telecom profile for phase/time synchronization with full timing support from the network*.

[b-ITU-T J.83] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound and data services for cable distribution*.

[b-ITU-T J.112] Recommendation ITU-T J.112 (1998), *Transmission systems for interactive cable television services*.

[b-ITU-T J.122] Recommendation ITU-T J.122 (2007), *Second-generation transmission systems for interactive cable television services – IP cable modems*.

[b-ITU-T J.126] Recommendation ITU-T J.126 (2007), *Embedded Cable Modem device specification*.

[b-ITU-T J.162] Recommendation ITU-T J.162 (2007), *Network call signalling protocol for the delivery of time-critical services over cable television networks using cable modems.*

[b-ITU-T J.163] Recommendation ITU-T J.163 (2007), *Dynamic quality of service for the provision of real-time services over cable television networks using cable modems.*

[b-ITU-T J.179] Recommendation ITU-T J.179 (2005), *IPCablecom support for multimedia*.

[b-ITU-T J.210] Recommendation ITU-T J.210 (2006), *Downstream RF interface for cable modem termination systems.*

[b-ITU-T J.211] Recommendation ITU-T J.211 (2006), *Timing interface for cable modem termination systems*.

[b-ITU-T J.212] Recommendation ITU-T J.212 (2006), *Downstream external Physical layer interface for modular cable modem termination systems*.

[b-ITU-T J.213] Recommendation ITU-T J.213 (2006), *Layer 2 virtual private networks for IP cable modem systems*.

[b-ITU-T J.222.x] Recommendations ITU-T J.222.x-series (2007), *Third-generation transmission systems for interactive cable television services – IP cable modems*.

[b-ITU-T J.223.x] Recommendation ITU-T J.223.x-series (2016), *Cabinet DOCSIS (C-DOCSIS) functional requirements; system specification*.

[b-ITU-T X.25] Recommendation ITU-T X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*.

[b-ITU-T X.509] Recommendation ITU-T X.509 (2012) | ISO/IEC 9594-8:2017, *Information technology – Open Systems Interconnection – The Directory: Public key and attribute certificate frameworks*.

[b-ITU-T X.690] Recommendation ITU-T X.690 (2015) | ISO/IEC 8825-1:2002, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*

Bibliography

Other references for specifications listed in clause 2

The following is a list of other references for the specifications listed in clause 2.

[b-ITU-T J-Sup.10] ITU-T J-series Recommendations – Supplement 10 (2020), *Correspondence between CableLabs DOCSIS specifications and ITU-T J-series Recommendations*.

[b-IEC 61169-24] IEC 61169-24:2001, *Radio-frequency connectors – Part 24: Sectional specification – Radio frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (type F)*.

[b-ISO/IEC 8802-2] ISO/IEC 8802-2:1998, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control*.

[b-ISO/IEC 8802-3] ISO/IEC 8802-3:2000, *Information technology, Telecommunications and information exchange between systems, Local and metropolitan area networks, Specific requirements, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*.

[b-ISO/IEC 8825-1] ISO/IEC 8825-1:2008, *Information technology – ASN.1 encoding rules: Specification of basic encoding rules (BER) – canonical encoding rules (CER) and distinguished encoding rules (DER)*.

[b-ISO/IEC 8859-1] ISO/IEC 8859-1:1998, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No.1*.

[b-ISO/IEC 10038] ISO/IEC 10038:1993, *Information technology – Telecommunications and information exchange between systems – Local area networks – Media access control (MAC) bridges*.

[b-ISO/IEC 13818-1] ISO/IEC 13818-1:2007, *Information technology – Generic coding of moving pictures and associated audio information: Systems*.

[b-CENELEC EN 50083-1] CENELEC EN 50083-1:2002, *Cable networks for television signals, sound signals and interactive services – Part 1: Safety requirements*.

[b-CENELEC EN 50083-2] CENELEC EN 50083-2:2005, *Cable networks for television signals, sound signals and interactive services – Part 2: Electromagnetic compatibility for equipment*.

[b-CENELEC EN 50083-7] CENELEC EN 50083-7:1996, *Cable networks for television signals, sound signals and interactive services – Part 7: System performance*.

[b-CENELEC EN 61000-6-3] CENELEC EN 61000-6-3:2003, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments.*

[b-CENELEC EN 61000-6-4] CENELEC EN 61000-6-4:2001, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Immunity for residential, commercial and light-industrial environments*.

[b-ETSI EG 201 212] ETSI EG 201 212 V1.2.1 (1998), *Electrical safety; Classification of interfaces for equipment to be connected to telecommunication networks*.

[b-ETSI EN 302 769] ETSI EN 302 769 V1.2.1 (2011), *Digital video broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2)*.

[b-ETSI EN 300 429] ETSI EN 300 429 V1.2.1 (1998), *Digital video broadcasting (DVB); Framing structure, channel coding and modulation for cable systems*.

[b-CAN/CSA CISPR 22-10] *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement* (Adopted IEC CISPR 22 (2008), sixth edition, 2008-09).

[b-FCC 47 CFR 15] Federal Communications Commission (2005), *Code of Federal Regulations – Title 47, Telecommunication – Part 15: Radio frequency devices*.

[b-FCC 47 CFR 76] Federal Communications Commission (2005), *Code of Federal Regulations – Title 47, Telecommunication – Part 76: Multichannel video and cable television service*.

[b-FIPS 46-3] Federal Information Processing Standard Publication (FIPS PUB) 46-3 (1999), *Data encryption standard (DES)*.

[b-FIPS 140-2] Federal Information Processing Standard Publication (FIPS PUB) 140-2 (2001), *Security requirements for cryptographic modules*.

[b-FIPS 180-1] FIPS PUB 180-1, Secure *hash standard* (1993).

[b-FIPS 180-4] Federal Information Processing Standard Publication (FIPS PUB) 180-4 (2014), *Secure hash standard (SHS)*.

[b-FIPS 197] Federal Information Processing Standard Publication (FIPS PUB) 197 (2001), *Advanced encryption standard (AES)*.

[b-GB 8898-2011] GB 8898-2011, *Audio, video and similar electronic apparatus – Safety requirements.*

[b-IEEE 802.1D] IEEE Std 802.1D-2004, *IEEE Standard for local and metropolitan area networks: Media access control (MAC) bridges.*
Incorporates IEEE 802.1t-2001 and IEEE 802.1w.

[b-IEEE 802.1ad] IEEE Std. 802.1ad-2005, *IEEE Standard for local and metropolitan area networks – Virtual bridged local area networks amendment 4: Provider bridges*. Former amendment to 802.1Q, now part of 802.1Q-2011.

[b-IEEE 802.1ah] IEEE Std. 802.1ah-2008, *IEEE Standard for local and metropolitan area networks – Virtual bridged local area networks – Amendment 7: Provider backbone bridges*. Former amendment to 802.1Q, now part of 802.1Q-2011.

[b-IEEE 802.3as] IEEE Std. 802.3as-2006, *IEEE Standard for information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.*

[b-IEEE 802.1Q] IEEE Std. 802.1Q-2011, *IEEE Standard for local and metropolitan area networks – Media access control (MAC) Bridges and virtual bridge local area networks*.

[b-IEEE 1588] IEEE Std. 1588-2008, *IEEE Standard for a precision clock synchronization protocol for networked measurement and control systems*.

[b-NIST SP 800-38A] NIST SP 800-38A (2001), *Recommendation for block cipher modes of operation, methods and techniques*.

[b-CANN] CL-SP-CANN-I19-190422, *CableLabs specifications – CableLabs' assigned names and numbers.* Cable Television Laboratories, Inc.

[b-CANN DHCP-Reg] CL-SP-CANN-DHCP-Reg-I15-180509, *CableLabs' DHCP options registry specification.* Cable Television Laboratories, Inc.

[b-C-DOCSIS] CM-SP-CDOCSIS-I02-150305, *Data-over-cable service interface specifications, C-DOCSIS – C-DOCSIS system specification.* Cable Television Laboratories, Inc.

[b-CLABDEF-MIB] CL-SP-MIB-CLABDEF-I12-160325, *CableLabs definition MIB specification*. Cable Television Laboratories, Inc.

[b-CMCIv3.0] CM-SP-CMCIv3.0-I03-170510, *Data-over-cable service interface specifications – Cable modem to customer premise equipment interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS BPI+] CM-SP-BPI+-C01-081104, *Data-over-cable service interface specifications – Baseline privacy interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS DEPI] CM-SP-DEPI-I08-100611, *Data-over-cable service interface specifications, modular headend architecture – Downstream external-PHY interface*. Cable Television Laboratories, Inc.

[b-DOCSIS DRFI] CM-SP-DRFI-I16-170111, *Data-over-cable service interface specifications – Downstream RF interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS DSG] CM-SP-DSG-I25-170906, *Data-over-cable service interface specifications – Set-top gateway (DSG) interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS DTI] CM-SP-DTI-I06-150305, *Data-over-cable service interface specifications, Modular headend architecture – DOCSIS timing interface specification*. Cable Televisions Laboratories, Inc.

[b-DOCSIS eDOCSIS] CM-SP-eDOCSIS-I30-190213, *Data-over-cable service interface specifications, eDOCSIS specification*. Cable Television Laboratories, Inc.

[b-DOCSIS L2VPN] CM-SP-L2VPN-I15-150528, *Data-over-cable service interface specifications, Business services over DOCSIS – Layer 2 virtual private networks.* Cable Television Laboratories, Inc.

[b-DOCSIS LLX] CM-SP-LLX-I02-20623, *Data over cable service interface specification, mobile applications – Low latency mobile Xhaul over DOCSIS® technology*, Cable Television Laboratories, Inc.

[b-DOCSIS M-OSSI] CM-SP-M-OSSI-I08-081209, *Data-over-cable service interface specifications, Modular headend architecture – M-CMTS operations support system interface specification.* Cable Television Laboratories, Inc.

[b-DOCSIS MULPIv3.0] CM-SP-MULPIv3.0-C01-171207, *Data-over-cable service interface specifications, DOCSIS 3.0 – MAC and upper layer protocols interface specification.* Cable Television Laboratories, Inc.

[b-DOCSIS MULPIv3.1] CM-SP-MULPIv3.1-I20-200407, *Data-over-cable service interface specifications, DOCSIS 3.1 – MAC and upper layer protocols interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS OSSIv2.0] CM-SP-OSSIv2.0-C01-081104, *Data-over-cable service interface specifications, DOCSIS 2.0 – Operations support system interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS OSSIv3.0] CM-SP-OSSIv3.0-C01-171207, *Data-over-cable service interface specifications, DOCSIS 3.0 – Operations support system interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS PHYv3.0] CM-SP-PHYv3.0-C01-171207, *Data-over-cable service interface specifications, DOCSIS 3.0 – Physical layer specification*. Cable Television Laboratories, Inc.

[b-DOCSIS R-DEPI] CM-SP-R-DEPI-I12-190307, *Data-over-cable service interface specifications, DCA – MHAv2 – Remote downstream external PHY interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS-R-PHY] CM-SP-R-PHY-I12-190307, *Data-over-cable service interface specifications, DCA – MHAv2 – Remote PHY specification.* Cable Television Laboratories, Inc.

[b-DOCSIS RFIv1.1] CM-SP-RFIv1.1-C01-050907, *Data-over-cable service interface specifications, DOCSIS 1.1 – Radio frequency interface specification*. Cable Television Laboratories, Inc.

[b-DOCSIS RFIv2.0] CM-SP-RFIv2.0-C02-090422, *Data-over-cable service interface specifications, DOCSIS 2.0 – Radio frequency interface specification.* Cable Television Laboratories, Inc.

[b-DOCSIS RMI] CM-SP-RMI-SDR-I02-150528, *Data-over-cable service interface specifications, Resource management interface – Service discovery and registration specification*. Cable Television Laboratories, Inc.

[b-DOCSIS SECv3.0] CM-SP-SECv3.0-C01-171207, *Data-over-cable service interface specifications, DOCSIS 3.0 – Security specification*. Cable Television Laboratories, Inc.

[b-DOCSIS SECv3.1] CM-SP-SECv3.1-I07-170111, *Data-over-cable service interface specifications, DOCSIS 3.1 – Security specification*. Cable Television Laboratories, Inc.

[b-DOCSIS OSSIv1.0] DPoE-SP-OSSIv1.0-C01-160830, *Cable data services, DOCSIS provisioning of EPON Specifications – DPoE operations and support system interface specification.* Cable Television Laboratories, Inc.

[b-DOCSIS OSSIv2.0] DPoE-SP-OSSIv2.0-I12-180228, *DOCSIS provisioning of EPON specifications, DPoEv2.0 – DPoE operations and support system interface specification*. Cable Television Laboratories, Inc.

[b-PKT-SP-DQOS] PKT-SP-DQOS-C01-071129 (2007), *PacketCable dynamic quality-of-service specification*. Cable Television Laboratories. Inc.

[b-PKT-SP-EC-MGCP] PKT-SP-EC-MGCP-C01-071129 (2007), *PacketCable network-based call signaling protocol specification*. Cable Television Laboratories, Inc.

[b-PKT-SP-MM] PKT-SP-MM-I07-151111, *PacketCable specification – Multimedia specification*. Cable Television Laboratories, Inc.

[b-PKT-SP-SEC] PKT-SP-SEC-C01-071129 (2007), *PacketCable security specification*. Cable Television Laboratories, Inc.

[b-CCAP-CONFIG-YANG] CCAP YANG configuration module. http://mibs.cablelabs.com/YANG/DOCSIS/3.1/

[b-CCAP-EVENTS-YANG] CCAP YANG, Module for Event Messaging, CCAPevents.yang, http://mibs.cablelabs.com/YANG/DOCSIS/

[b-CCAP-MIB] Converged Cable Access Platform MIB, CCAP-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS

[b-CLAB-TOPO-MIB] CableLabs Topology MIB, CLAB-TOPO-MIB, http://mibs.cablelabs.com/MIBs/common/

[b-DOCS-BPI2EXT-MIB] CableLabs DOCSIS DOCS-BPI2EXT-MIB SNMP MIB Module, DOCS-BPI2EXT-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS

[b-DOCS-DIAG-MIB] DOCSIS Diagnostic Log MIB, DOCS-DIAG-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-IF3-MIB] DOCSIS Interface 3 MIB Module, DOCS-IF3-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-IF31-MIB] DOCSIS Interface 3.1 MIB Module, DOCS-IF31-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-IFEXT2-MIB] DOCSIS Interface Extension 2 MIB Module, DOCS-IFEXT2-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-LOADBAL3-MIB] DOCSIS Load Balancing 3 MIB Module, DOCS-LOADBAL3-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-MCAST-MIB] DOCSIS Multicast MIB Module, DOCS-MCAST-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-MCAST-AUTH-MIB] DOCSIS Multicast Authorization MIB Module, DOCS-MCAST-AUTH-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-PNM-MIB] DOCSIS PNM MIB Module, DOCS-PNM-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-QOS3-MIB] DOCSIS Quality of Service 3 MIB Module, DOCS-QOS3-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-SEC-MIB] DOCSIS Security MIB, DOCS-SEC-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCS-SUBMGT3-MIB] DOCSIS Subscriber Management 3 MIB, DOCS-SUBMGT3-MIB, http://mibs.cablelabs.com/MIBs/DOCSIS/

[b-DOCSIS-CM] DOCSIS CM Information Schema, DOCSIS-CM_3.5.1-A.3.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CM/

[b-DOCSIS-CMTS] DOCSIS CMTS Information Schema, DOCSIS-CMTS_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS/

[b-DOCSIS-OFDM] DOCSIS CMTS CM Downstream OFDM Information Schema, DOCSIS-CMTS-CM-DS-OFDM_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-DS-OFDM/

[b-DOCSIS-PROFILE-STATUS] DOCSIS CMTS CM Downstream OFDM Profile Status Type Schema, DOCSIS-CMTS-CM-DS-OFDM-PROFILE-STATUS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-DS-OFDM-PROFILE-STATUS-TYPE/

[b-DOCSIS-STATUS] DOCSIS CMTS CM Downstream OFDM Status Type Schema, DOCSIS-CMTS-CM-DS-OFDM-STATUS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-DS-OFDM-STATUS-TYPE/

[b-DOCSIS-CMTS-CM-NODE-CH] DOCSIS CMTS CM Node Channel Information Schema, DOCSIS-CMTS-CM-NODE-CH_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-NODE-CH/

[b-DOCSIS-CMTS-CM-PARTIAL] DOCSIS CMTS CM Partial Service/Channel Information Schema, DOCSIS-CMTS-CM-PARTIAL_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-PARTIAL/

[b-DOCSIS-REG] DOCSIS CMTS CM Registration Status Type Schema, DOCSIS-CMTS-CM-REG-STATUS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-REG-STATUS-TYPE/

[b-DOCSIS-SERVICE-FLOW] DOCSIS CMTS CM Service Flow Type Schema, DOCSIS-CMTS-CM-SERVICE-FLOW-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-SERVICE-FLOW-TYPE/

[b-DOCSIS-CMTS-CM-US] DOCSIS CMTS CM Upstream Information Schema, DOCSIS-CMTS-CM-US_3.5.1-A.3.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US/

[b-DOCSIS-OFDMA] DOCSIS CMTS CM Upstream OFDMA Information Schema, DOCSIS-CMTS-CM-US-OFDMA_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-US-OFDMA/

[b-DOCSIS-OFDMA-PROFILE] DOCSIS CMTS CM Upstream OFDMA Profile Status Type Schema, DOCSIS-CMTS-CM-US-OFDMA-PROFILE-STATUS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-US-OFDMA-PROFILE-STATUS-TYPE/

[b-DOCSIS-OFDMA-STATUS] DOCSIS CMTS CM Upstream OFDMA Status Type Schema, DOCSIS-CMTS-CM-US-OFDMA-STATUS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-CMTS-CM-US-OFDMA-STATUS-TYPE/

[b-DOCSIS-CM-US-STATS] DOCSIS CMTS CM Upstream Status Schema, DOCSIS-CMTS-CM-US-STATS-TYPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-CM-US-STATS-TYPE/

[b-DOCSIS-CMTS-DS-UTIL] DOCSIS CMTS Downstream Utilization Information Schema, DOCSIS-CMTS-DS-UTIL_3.5.1-A.4.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL/

[b-DOCSIS-DS-UTIL-STATS] DOCSIS CMTS Downstream Utilization Status Schema, DOCSIS-CMTS-DS-UTIL-STATS-TYPE_3.5.1-A.3.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-DS-UTIL-STATS-TYPE/

[b-DOCSIS-CMTS-TOPOLOGY] DOCSIS CMTS Topology Type Schema, DOCSIS-CMTS-TOPOLOGY-TYPE_3.5.1-A.3.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-TOPOLOGY-TYPE/

[b-DOCSIS-CMTS-US-UTIL] DOCSIS CMTS Upstream Utilization Schema, DOCSIS-CMTS-US-UTIL_3.5.1-A.3.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL/

[b-DOCSIS- US-UTIL-STATS] DOCSIS CMTS Upstream Utilization Status Schema, DOCSIS-CMTS-US-UTIL-STATS-TYPE_3.5.1-A.5.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CMTS-US-UTIL-STATS-TYPE/

[b-DOCSIS-CPE] DOCSIS CPE Information Schema, DOCSIS-CPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE/

[b-DOCSIS-CPE-TYPE] DOCSIS CPE Type Schema, DOCSIS-CPE-TYPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-CPE-TYPE/

[b-DOCSIS-DIAG-LOG] DOCSIS Diagnostic Log Information Schema, DOCSIS-DIAG-LOG_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG/

[b-DOCSIS-DIAG-LOG-DETAIL] DOCSIS Diagnostic Log Detail Schema, DOCSIS-DIAG-LOG-DETAIL_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL/

[b-DOCSIS-DIAG-LOG-DETAIL] DOCSIS Diagnostic Log Detail Type Schema, DOCSIS-DIAG-LOG-DETAIL-TYPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-DETAIL-TYPE/

[b-DOCSIS-DIAG-LOG-EVENT] DOCSIS Diagnostic Log Event Type Schema, DOCSIS-DIAG-LOG-EVENT-TYPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-EVENT-TYPE/

[b-DOCSIS-DIAG-LOG-TYPE] DOCSIS Diagnostic Log Type Schema, DOCSIS-DIAG-LOG-TYPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-DIAG-LOG-TYPE/

[b-DOCSIS-DS-PROF-STATS] DOCSIS Downstream OFDM Profile Stats Type Schema, DOCSIS-DS-OFDM-PROFILE-STATS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-DS-OFDM-PROFILE-STATS-TYPE/

[b-DOCSIS-IP-MULTICAST] DOCSIS IP Multicast Information Schema, DOCSIS-IP-MULTICAST_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST/

[b-DOCSIS-IP-MULTIC-STATS] DOCSIS IP Multicast Statistics Type Schema, DOCSIS-IP-MULTICAST-STATS-TYPE_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-IP-MULTICAST-STATS-TYPE/

[b-DOCSIS-MD-NODE] DOCSIS MAC Domain Node Information Schema, DOCSIS-MD-NODE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-MD-NODE/

[b-DOCSIS-OFDM-PROFILE] DOCSIS OFDM Profile Information Schema, DOCSIS-OFDM-PROFILE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-OFDM-PROFILE/

[b-DOCSIS-QOS] DOCSIS QoS Information Schema, DOCSIS-QOS_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-QOS/

[b-DOCSIS-REC] DOCSIS Record Information Schema, DOCSIS-REC_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-REC/

[b-DOCSIS-SAMIS-TYPE-1] DOCSIS SAMIS Type 1 Schema, DOCSIS-SAMIS-TYPE1_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-TYPE-1/

[b-DOCSIS-SAMIS-TYPE-2] DOCSIS SAMIS Type 2 Schema, DOCSIS-SAMIS-TYPE-2_3.5.1-A.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SAMIS-TYPE-2/

[b-DOCSIS-SERVICE-FLOW] DOCSIS Service Flow Information Schema, DOCSIS-SERVICE-FLOW_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-SERVICE-FLOW/

[b-DOCSIS-SPECTRUM] DOCSIS Spectrum Measurement Information Schema, DOCSIS-SPECTRUM_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM/

[b-DOCSIS-SPECTRUM-MEAS] DOCSIS Spectrum Measurement Type Schema, DOCSIS-SPECTRUM-MEASUREMENT-TYPE_3.5.1-A.2.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.0/xsd/ipdr/DOCSIS-SPECTRUM-MEASUREMENT-TYPE/

[b-DOCSIS-US-PROF-STATS] DOCSIS Upstream OFDMA Profile Stats Type, DOCSIS-US-OFDMA-PROFILE-STATS-TYPE_3.5.1-B.1.xsd, http://mibs.cablelabs.com/namespaces/DOCSIS/3.1/xsd/ipdr/DOCSIS-US-OFDMA-PROFILE-STATS-TYPE/

[b-IANA Port Nos] Internet Assigned Numbers Authority (Internet), *Service name and transport protocol port number registry*. http://www.iana.org/assignments/port-numbers

[b-IETF RFC 768] IETF RFC 768/STD0006 (1980), *User datagram protocol*.

[b-IETF RFC 826] IETF RFC 826/STD0037 (1982), *An Ethernet address resolution protocol or converting network protocol addresses to 48.bit Ethernet address for transmission on Ethernet hardware*.

[b-IETF RFC 868] IETF RFC 868/STD0026 (1983), *Time protocol*.

[b-IETF RFC 1042] IETF RFC 1042 (1988), *A standard for the transmission of IP datagrams over IEEE 802 networks*.

[b-IETF RFC 1112] IETF RFC 1112 (1989), *Host extensions for IP multicasting*.

[b-IETF RFC 1157] IETF RFC 1157 (1990), *A simple network management protocol (SNMP)*.

[b-IETF RFC 1191] IETF RFC 1191 (1990), *Path MTU discovery*.

[b-IETF RFC 1350] IETF RFC 1350/STD0033 (1992), *The TFTP protocol (revision 2)*.

[b-IETF RFC 1493] IETF RFC 1493 (1993), *Definitions of managed objects for bridges*.

[b-IETF RFC 1700] IETF RFC 1700 (1994), *Assigned numbers*.

[b-IETF RFC 1812] IETF RFC 1812 (1995), *Requirements for IP version 4 routers*.

[b-IETF RFC 1832] IETF RFC 1832 (1995), *XDR: External data representation standard*.

[b-IETF RFC 1901] IETF RFC 1901 (1996), *Introduction to community-based SNMPv2*.

[b-IETF RFC 1945] IETF RFC 1945 (1996), *Hypertext transfer protocol – HTTP/1.0*.

[b-IETF RFC 1981] IETF RFC 1981 (1996), *Path MTU discovery for IP version 6*.

[b-IETF RFC 2104] IETF RFC 2104 (1997), *HMAC: Keyed-hashing for message authentication*.

[b-IETF RFC 2131] IETF RFC 2131 (1997), *Dynamic host configuration protocol*.

[b-IETF RFC 2132] IETF RFC 2132 (1997), *DHCP options and BOOTP vendor extensions*.

[b-IETF RFC 2133] IETF RFC 2133 (1997), *Basic socket interface extensions for IPv6*.

[b-IETF RFC 2236] IETF RFC 2236 (1997), *Internet group management protocol, Version 2*.

[b-IETF RFC 2309] IETF RFC 2309 (1998), *Recommendations on queue management and congestion avoidance in the Internet*.

[b-IETF RFC 2347] IETF RFC 2347, *TFTP option extension*.

[b-IETF RFC 2348] IETF RFC 2348 (1998), *TFTP blocksize option*.

[b-IETF RFC 2349] IETF RFC 2349 (1998), *TFTP timeout interval and transfer size options*.

[b-IETF RFC 2460] IETF RFC 2460 (1998), *Internet protocol, version 6 (IPv6) – Specification*.

[b-IETF RFC 2461] IETF RFC 2461 (1998), *Neighbor discovery for IP Version 6 (IPv6)*.

[b-IETF RFC 2462] IETF RFC 2462 (1998), *IPv6 stateless address autoconfiguration*.

[b-IETF RFC 2464] IETF RFC 2464 (1998), *Transmission of IPv6 packets over Ethernet networks*.

[b-IETF RFC 2474] IETF RFC 2474 (1998), *Definition of the differentiated services field (DS field) in the IPv4 and IPv6 headers*.

[b-IETF RFC 2560] IETF RFC 2560 (1999), *X.509 Internet public key infrastructure online certification status protocol – OCSP*.

[b-IETF RFC 2573] IETF RFC 2573 (1999), *SNMP applications*.

[b-IETF RFC 2575] IETF RFC 2575 (1999), *View-based access control model (VACM) for the simple network management protocol (SNMP)*.

[b-IETF RFC 2578] IETF RFC 2578 (1999), *Structure of management information version 2 (SMIv2)*.

[b-IETF RFC 2580] IETF RFC 2580 (1999), *Conformance statements for SMIv2*.

[b-IETF RFC 2616] IETF RFC 2616 (1999), *Hypertext transfer protocol – HTTP/1.1*.

[b-IETF RFC 2669] IETF RFC 2669 (1999), *DOCSIS cable device MIB cable device management information base for DOCSIS compliant cable modems and cable modem termination systems*.

[b-IETF RFC 2710] IETF RFC 2710 (1999), *Multicast listener discovery (MLD) for IPv6*.

[b-IETF RFC 2786] IETF RFC 2786 (2000), *Diffie-Helman USM key – Management information base and textual convention*.

[b-IETF RFC 2790] IETF RFC 2790 (2000), *Host resources MIB.*

[b-IETF RFC 2821] IETF RFC 2821 (2001), *Simple mail transfer protocol*.

[b-IETF RFC 2856] IETF RFC 2856 (2000), *Textual conventions for additional high capacity data types*.

[b-IETF RFC 2863] IETF RFC 2863 (2000), *The interfaces group MIB.*

[b-IETF RFC 2933] IETF RFC 2933 (2000), *Internet group management protocol MIB.*

[b-IETF RFC 3019] IETF RFC 3019 (2001), *IP version 6 management information base for the multicast listener discovery protocol*.

[b-IETF RFC 3032] IETF RFC 3032 (2001), *MPLS label stack encoding*.

[b-IETF RFC 3046] IETF RFC 3046 (2001), *DHCP relay agent information option*.

[b-IETF RFC 3083] IETF RFC 3083 (2001), *Baseline privacy interface management information base for DOCSIS compliant cable modems and cable modem termination systems*.

[b-IETF RFC 3164] IETF RFC 3164 (2001), *The BSD syslog protocol*.

[b-IETF RFC 3203] IETF RFC 3203 (2001), *DHCP reconfigure extension*.

[b-IETF RFC 3219] IETF RFC 3219 (2002), *Telephony routing over IP (TRIP)*.

[b-IETF RFC 3256] IETF RFC 3256 (2002), *The DOCSIS (data-over-cable service interface specifications) device class DHCP (dynamic host configuration protocol) relay agent information sub-option*.

[b-IETF RFC 3289] IETF RFC 3289 (2002), *Management information base for the differentiated services architecture*.

[b-IETF RFC 3306] IETF RFC 3306 (2002), *Unicast-prefix-based IPv6 multicast addresses*.

[b-IETF RFC 3376] IETF RFC 3376 (2002), *Internet group management protocol, version 3*.

[b-IETF RFC 3410] IETF RFC 3410 (2002), *Introduction and applicability statements for Internet-standard management framework.*

[b-IETF RFC 3411] IETF RFC 3411/STD0062 (2002), *An architecture for describing simple network management protocol (SNMP) management frameworks.*

[b-IETF RFC 3412] IETF RFC 3412 (2002), *Message processing and dispatching for the simple network management protocol (SNMP).*

[b-IETF RFC 3413] IETF RFC 3413/STD0062 (2002), *Simple network management protocol (SNMP) applications.*

[b-IETF RFC 3414] IETF RFC 3414/STD0062 (2002), *User-based security model (USM) for version 3 of the simple network management protocol (SNMPv3).*

[b-IETF RFC 3415] IETF RFC 3415 (2002), *View-based access control model (VACM) for the simple network management protocol (SNMP).*

[b-IETF RFC 3416] IETF RFC 3416 (2002), *Version 2 of the protocol operations for the simple network management protocol (SNMP).*

[b-IETF RFC 3417] IETF RFC 3417 (2002), *Transport mappings for the simple network management protocol (SNMP).*

[b-IETF RFC 3418] IETF RFC 3418/STD0062 (2002), *Management information base (MIB) for the simple network management protocol (SNMP).*

[b-IETF RFC 3419] IETF RFC 3419 (2002), *Textual conventions for transport addresses.*

[b-IETF RFC 3433] IETF RFC 3433 (2002), *Entity sensor management information base*.

[b-IETF RFC 3484] IETF RFC 3484 (2003), *Default address selection for Internet protocol version 6 (IPv6)*.

[b-IETF RFC 3633] IETF RFC 3633 (2003), *IPv6 prefix options for dynamic host configuration protocol (DHCP) version 6*.

[b-IETF RFC 3635] IETF RFC 3635 (2003), *Definitions of managed objects for the Ethernet-like interface types*.

[b-IETF RFC 3810] IETF RFC 3810 (2004), *Multicast listener discovery version 2 (MLDv2) for IPv6*.

[b-IETF RFC 3826] IETF RFC 3826 (2004), *The advanced encryption standard (AES) cipher algorithm in the SNMP user-based security model*.

[b-IETF RFC 3927] IETF RFC 3927 (2005), *Dynamic configuration of IPv4 link-local addresses.*

[b-IETF RFC 4022] IETF RFC 4022 (2005), *Management information base for the transmission control protocol (TCP).*

[b-IETF RFC 4113] IETF RFC 4113 (2005), *Management information base for the user datagram protocol (UDP).*

[b-IETF RFC 4131] IETF RFC 4131 (2005), *Management information base for data over cable service interface specification (DOCSIS) cable modems and cable modem termination systems for baseline privacy plus*.

[b-IETF RFC 4181] IETF RFC 4181 (2005), *Guidelines for authors and reviewers of MIB documents*.

[b-IETF RFC 4188] IETF RFC 4188 (2005), *Definitions of managed objects for bridges*.

[b-IETF RFC 4250] IETF RFC 4250 (2006), *The secure shell (SSH) protocol assigned numbers.*

[b-IETF RFC 4251] IETF RFC 4251 (2006), *The secure shell (SSH) protocol architecture*.

[b-IETF RFC 4252] IETF RFC 4252 (2006), *The secure shell (SSH) authentication protocol*.

[b-IETF RFC 4253] IETF RFC 4253 (2006), *The secure shell (SSH) transport layer protocol*.

[b-IETF RFC 4254] IETF RFC 4254 (2006), *The secure shell (SSH) connection protocol*.

[b-IETF RFC 4293] IETF RFC 4293 (2006), *Management information base for the Internet protocol (IP)*.

[b-IETF RFC 4303] IETF RFC 4303 (2005), *IP encapsulating security payload (ESP)*.

[b-IETF RFC 4323] IETF RFC 4323 (2006), *Data over cable system interface specification quality of service management information base (DOCSIS-QOS-MIB)*.

[b-IETF RFC 4361] IETF RFC 4361 (2006), *Node-specific client identifiers for dynamic host configuration protocol version four (DHCPv4)*.

[b-IETF RFC 4506] IETF RFC 4506/STD0067 (2006), *XDR: External data representation standard*.

[b-IETF RFC 4546] IETF RFC 4546 (2006), *Radio frequency (RF) interface management information base for data over cable service interface specifications (DOCSIS) 2.0 compliant RF interfaces*.

[b-IETF RFC 4601] IETF RFC 4601 (2006), *Protocol independent multicast-sparse mode (PIM-SM): Protocol specification (revised)*.

[b-IETF RFC 4604] IETF RFC 4604 (2006), H. Holbrook, B. Cain, B. Haberman, *Using IGMPv3 and MLDv2 for Source-Specific Multicast*.

[b-IETF RFC 4605] IETF RFC 4605 (2006), *Internet Group Management Protocol (IGMP)/multicast listener discovery (MLD)-based multicast forwarding ("IGMP/MLD proxying")*.

[b-IETF RFC 4607] IETF RFC 4607 (2006), *Source-specific multicast for IP*.

[b-IETF RFC 4639] IETF RFC 4639 (2006), *Cable device management information base for data-over-cable service interface specification (DOCSIS) compliant cable modems and cable modem termination systems*.

[b-IETF RFC 4649] IETF RFC 4649 (2006), B. Volz, *Dynamic host configuration protocol for IPv6 (DHCPv6) relay agent remote-ID option*.

[b-IETF RFC 4742] IETF RFC 4742 (2006), *Using the NETCONF configuration protocol over secure shell (SSH)*.

[b-IETF RFC 4861] IETF RFC 4861 (2007), *Neighbor discovery for IP version 6 (IPv6)*.

[b-IETF RFC 4862] IETF RFC 4862 (2007), *IPv6 stateless address autoconfiguration*.

[b-IETF RFC 5132] IETF RFC 5132 (2007), *IP multicast MIB*.

[b-IETF RFC 5246] IETF RFC 5246 (2008), *The transport layer security (TLS) protocol – Version 1.2*.

[b-IETF RFC 5277] IETF RFC 5277 (2008), *NETCONF event notifications*.

[b-IETF RFC 5280] IETF RFC 5280 (2008), *Internet X.509 public key infrastructure certificate and certificate revocation list (CRL) profile*.

[b-IETF RFC 5460] IETF RFC 5460 (2009), *DHCPv6 Bulk leasequery*.

[b-IETF RFC 5462] IETF RFC 5462 (2009), *Multiprotocol label switching (MPLS) label stack entry: "EXP" field renamed to "traffic class" field*.

[b-IETF RFC 6241] IETF RFC 6241 (2011), *Network configuration protocol (NETCONF)*.

[b-IETF RFC 6243] IETF RFC 6243 (2011), *With-defaults capability for NETCONF*.

[b-IETF RFC 6933] IETF RFC 6933 (2013), *Entity MIB (version 4)*.

[b-IETF RFC 6960] IETF RFC 6960 (2013), *X.509 Internet public key infrastructure online certificate status protocol – OCSP*.

[b-IETF RFC 6991] IETF RFC 6991 (2013), *Common YANG data types*.

[b-IETF RFC 7559] IETF RFC 7559 (2015), *Packet-loss resiliency for router solicitations*.

[b-IETF RFC 8311] IETF RFC 8311 (2018), D. Black, *Relaxing restrictions on explicit congestion notification (ECN) experimentation*.

[b-IETF RFC 8415] IETF RFC 8415 (2018), *Dynamic host configuration protocol for IPv6 (DHCPv6)*.

[b-IPDR/BSR] TM Forum (2009), *IPDR business solution requirements – Network data management usage (NDM-U)*, version 3.7.

[b-IPDR/CAPAB] TM Forum (2009), *IPDR/capability file format*, version 3.9.

[b-IPDR/SP] TM Forum, TMF8000-IPDR-IIS-PS (2011), *IPDR streaming protocol (IPDR/SP) specification*, version 2.7.

[b-IPDR/SSDG] TM Forum (2009), *IPDR service specification design guide*, version 3.8.

[b-IPDR/XDR] TM Forum (2009), *IPDR/XDR file encoding format*, version 3.5.1.

[b-PKCS_7] RSA Laboratories, PKCS_7: Cryptographic *message syntax standard* (1993), An RSA Laboratories Technical Note, Version 1.5.

[b-RSA1] RSA Laboratories (1993), *PKCS #1: RSA encryption standard. Version 1.5*.

[b-RSA3] RSA Laboratories (1999), *PKCS #1 v2.0: RSA cryptography standard*.

[b-SCTE 02] ANSI/SCTE 02 2015, *Specification for "F" port, female indoor*.

[b-SCTE 52] ANSI/SCTE 52 2013, *Data encryption standard – Cipher block chaining packet encryption specification*.

[b-SCTE 91] ANSI/SCTE 91 2015, *Specification for 5/8-24 RF and AC equipment port, female*.

[b-SCTE 154-2] ANSI SCTE 154-2 2018, *SCTE-HMS-QAM-MIB*.

[b-SCTE 154-4] ANSI SCTE 154-4 2018, *MPEG management information base SCTE-HMS-MPEG-MIB*.

[b-SCTE 154-5] ANSI SCTE 154-5 2018, *SCTE-HMS-headendident textual conventions MIB*.

[b-SCTE RMP] SCTE, ISBE TS46 (2012), *SCTE measurement recommended practices for cable systems*, fourth edition. https://www.scte.org/product-detail/scte-measurement-recommended-practices-for-cable-systems/

[b-USB] Compaq, Hewlett-Packard, Intel, Lucent, Microsoft, NEC, Philips (2000), *Universal serial bus specification, Revision 2.0*. http://www.usb.org

[b-W3XML1.0] W3C Recommendation 04 (2008), *Extensible markup language (XML) 1.0*, fifth edition.

[b-W3XSD1.0] W3C Recommendation 28 (2004), *XML schema Part 1: Structures*, Second Edition.

[b-MMH] Halevi, S., Krawczyk, H. MMH: Software message authentication in Gbit/sec rates. In: Biham E. (ed), *Fast Software Encryption, FSE 1997, Lecture Notes in Computer Science*, vol. 1267, pp. 172-189. Berlin: Springer, 1997.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	**Cable networks and transmission of television, sound programme and other multimedia signals**
Series K	Protection against interference
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2022